Space Weather Technical Forecast

Issued on Monday, 10 January 2022 at 12:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the past 24 hours with no notable flares, and background flux a B-class. There are five sunspot regions on the visible disc. AR2924 Eko/Beta, just west of the southern centre disc, is the largest, but is a stable and dynamically inactive region that has shown little sign of flaring. AR2925 Hsx/Beta is a small mature remnant spot, as is AR2927 Hsx/Beta although this is set amongst a large area of plage. Two further unnumbered small regions are visible, including a newly developed Bxo/Beta just west of centre disc.

No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds speeds, as observed by DSCOVR and ACE at L1 have been slightly elevated under the fast wind of CH43, persisting at around 420-480km/s, after initially easing from a peak of 550 km/s. Density varied around average values 8-13 ppcc for much of the period but declined to below average from 10/0830 UTC. Total Interplanetary Magnetic Field (IMF) strength, Bt, was weak at below 6nT, with the Bz component varying between +4 and -4nT. Phi angle was initially negative (towards the Sun), but exhibited a brief rotation to positive and then then back to negative, with some oscillations, but becoming persistently negative from 10/0400 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 0-3)

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at normal background levels throughout. Electron fluence remained well below the Active threshold (1e8 integrated pfu), with 1.53e6 integrated pfu recorded at 10/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Very Low, with a chance of C-class flares. There is a slight chance of M-flares, with an increasing chance day 3 (12th) onward, as far-side active regions that are currently producing visible CMEs rotate near to, or around the eastern limb.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing slightly elevated speeds due to the fast wind CH43 will gradually ease, with no further notable enhancements currently expected. Geomagnetic activity is forecast to be Quiet to Unsettled with a slight chance of Active intervals, mainly day 1 or early day 2 (10th or 11th).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at background levels. The high energy electron flux (greater than 2MeV) is likely to increase through this period as fast wind from CH43 wanes. This bringing a slight chance of Active fluence (1e8 integrated pfu) by the end of day 3 (12th).

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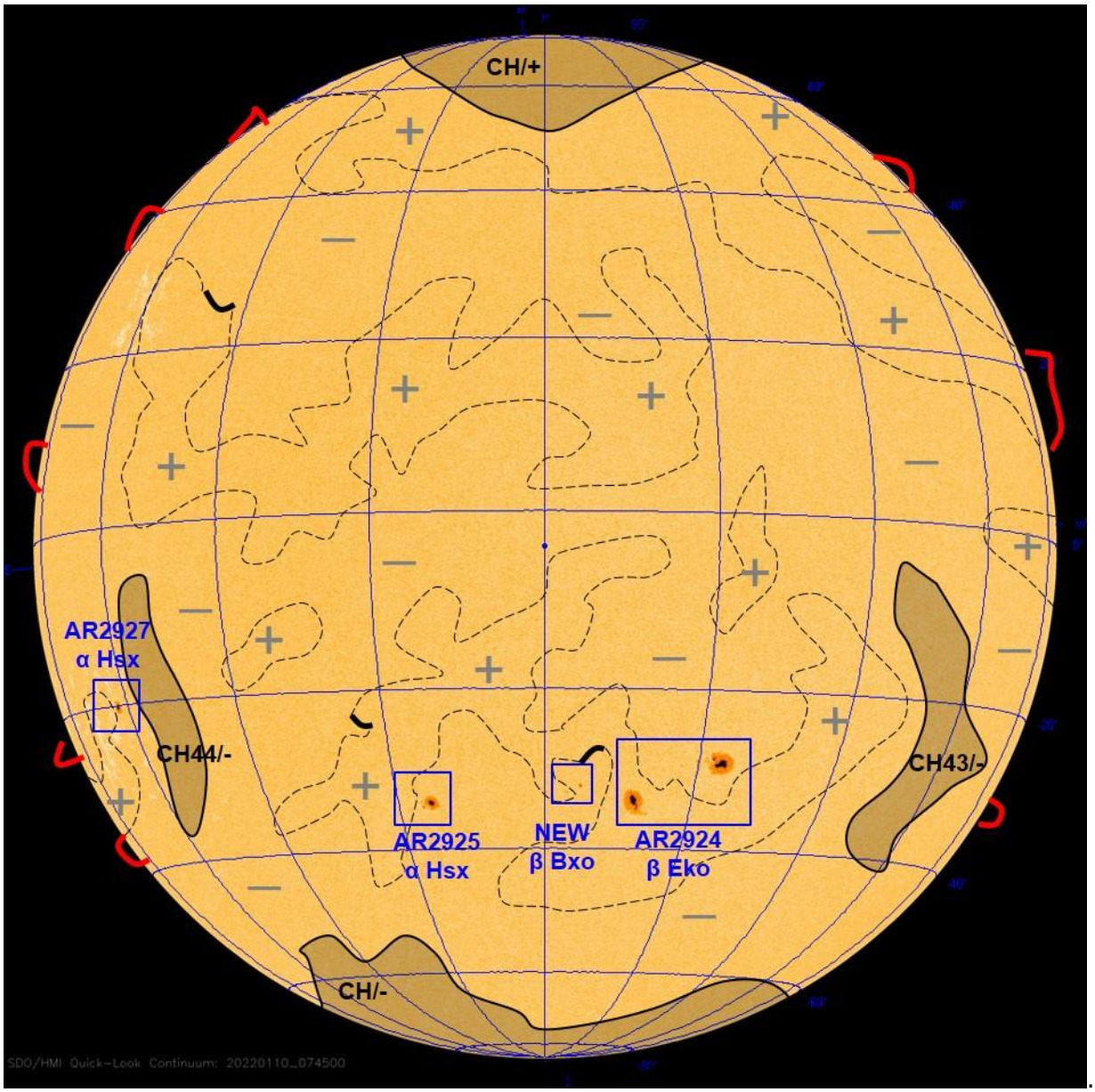
Figure 1. Solar Analysis Valid 10/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

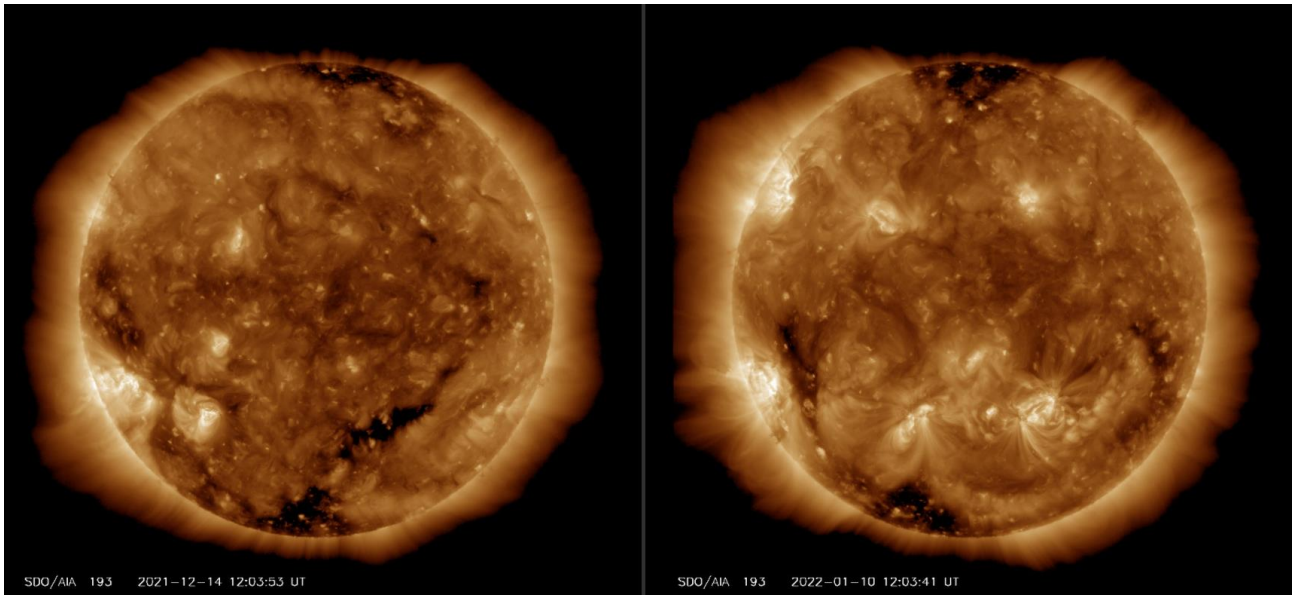
There are No Earth-directed CMEs. Earth is currently with the fast wind of non-recurrent CH43, with current slightly elevated solar winds expected to only gradually ease to background by end of day 2 or day 3 (11th or 12th). The next fast wind enhancement is expected from coronal hole 44, beyond the forecast period.

Mainly Quiet geomagnetic activity is expected, with a chance of Unsettled intervals. There is a slight chance of an isolated Active interval on day 1 or early day 2 (10th or 11th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Figure 2: SDO aia-193 of previous rotation (left) and current rotation (right). CH more advanced on this rotation, limiting value of persistence.



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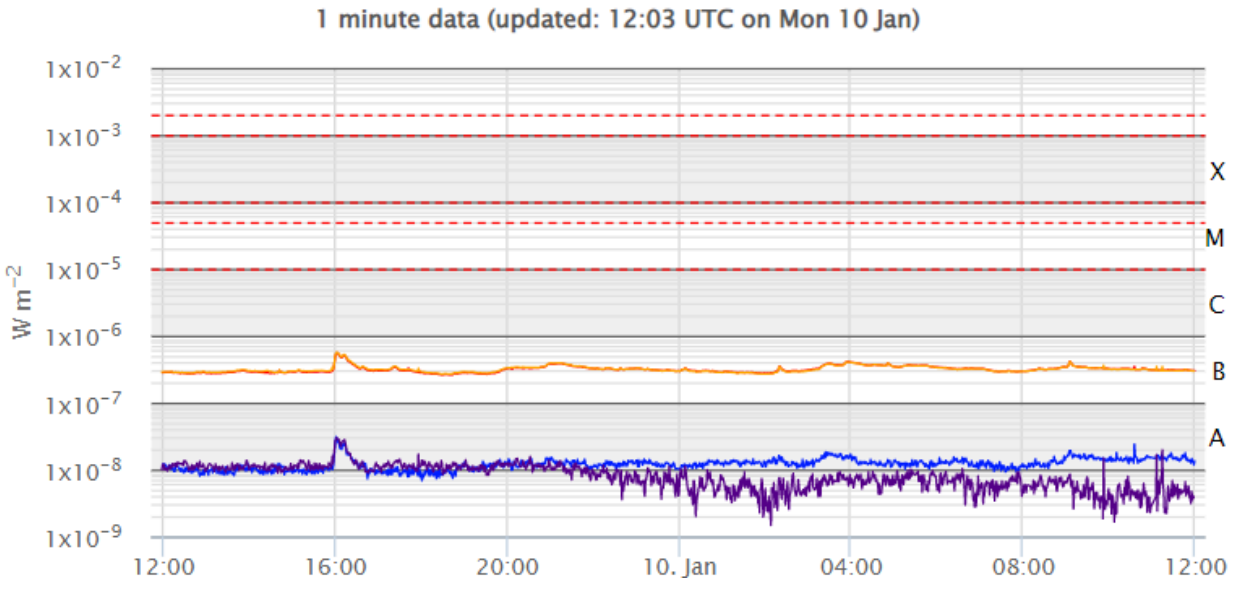
Radio Blackouts - X-Ray Flares:

Solar activity has remained Very Low in the last 24 hours with four active regions on the disc. AR2924 Eko/beta is the largest spot on the disc but is a mature and dynamically inactive region, reducing the potential for notable flares. AR2927, which is in the area of ex-AR2907/8 regions from the previous rotation is now a small, simple and mature Hsx/alpha region, set amongst an area of plage, and unlikely to produce significant flaring without redevelopment. AR2925 Hsx/alpha is also a small, mature unipolar spot which was more active on the far-side, but has remained inactive on the Earth-side. There are two further small sunspots that are unnumbered, including a newly developing region in the north, just west of centre disc. There is also a large area of plage in the northeast.

CMEs have been observed in coronagraph imagery from over the eastern limb, however, and these are likely associated with far-sided regions, potentially those seen on the previous rotation. This corresponds with increased signals also seen on far-side helioseismographs. This will likely increase X-ray flux later this week, and slightly increasing the current slight chance of M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	15	20
Very Active	R3 to R5 X Class	No	1	1	2	2

Figure 3: GOES 16/17 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at Background levels and will most likely persist at this level in the absence of solar activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: AR2924 intensitygram (left) and Magnetogram (right) (small unnumbered sunspot also visible to the left of trailer)

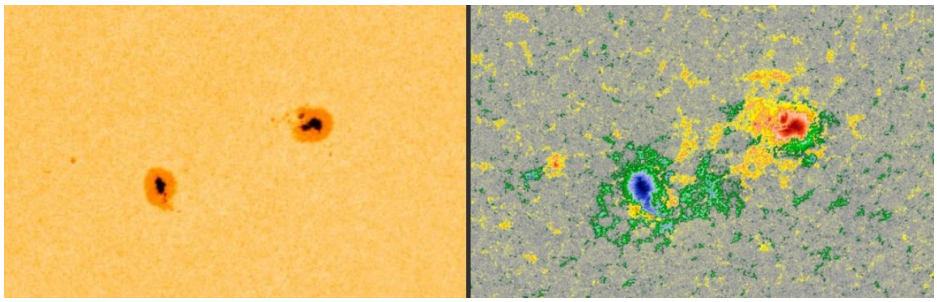
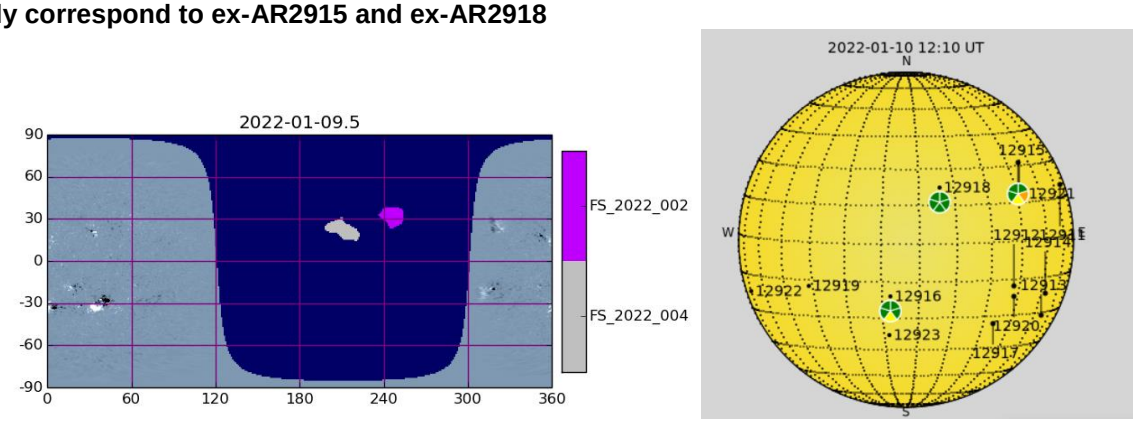


Figure 5: Helioseismic signal showing two large regions on far-side. Raben map, showing these potentially correspond to ex-AR2915 and ex-AR2918



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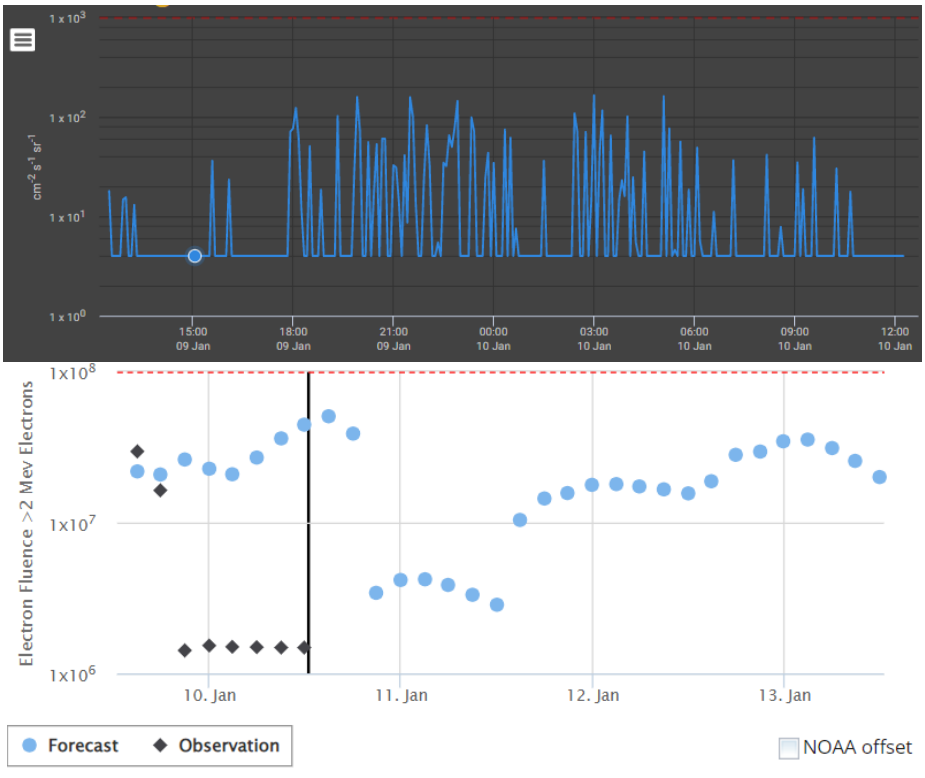
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been suppressed at Normal Background levels. Decompression of the radiation belts as the fast wind of CH44 eases is likely lead to flux levels at GEO rising later day 1 (10th) and more notably day 2 (11th) onward. However, the level of charging likely to occur during this period is not certain. As such, peaks above the High threshold are possible day 2 onward, although confidence remains low.

The associated 24 hour fluence will start well below the Active level (1e8 integrated pfu), but is likely to rise day 2 onward in response to the anticipated increased flux. This bringing a slight chance of Active (1e8 integrated pfu) fluence by the end of the period. REFM is showing a rising trend from day 2 (11 Jan), and this is considered good guidance for the expected trend, although peak values may exceed those indicated.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	20	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 6: >2MeV GOES-16 Electron Flux and Fluence with REFM



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